toms common to all patients suffering from schizophrenia, and the DSM-IV active symptoms for schizophrenia are often present in other psychiatric and neurological illnesses. In the absence of a sensitive or specific clinical phenotype for schizophrenia, clinical decision making is compromised and research on the cerebral and genetic basis for schizophrenia is undermined. Early neuropsychological investigations implicated the potential value of cognitive deficits to this delineation, but again the within-group heterogeneity and the lack of between-group specificity undermined the early optimism.

Participants and Methods: After a brief review of the general deficits associated with schizophrenia, a Screen for Cognitive Impairment in Psychiatry will be introduced along with normative evidence supporting the reliability of three alternate forms available in the English (SCIP) and Spanish (SCIP-S) languages collected over the past 8 years. Evidence supporting the validity and cross-cultural comparability of the SCIP for detection of cognitive deficits associated with schizophrenia and bipolar disorders will be provided by comparison of large clinical samples collected at multiple centers in Spain and Canada over the past three years.

Results: The results confirm the sensitivity of the SCIP to deficits in schizophrenia and bipolar disorder, and the consistency of the deficits in both a European and North American sample. The results also underscore the lack of specificity in the cognitive deficits apparent in schizophrenia.

Conclusions: Co-registration of a discrete cognitive impairment with a biological anomaly will be required to adequately define an endophenotype relevant to cerebral pathogenesis that could assist delineation of a schizophrenia genotype.

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Symposium 11

9:00–10:30 a.m.

Neuropsychological Contributions to Understanding the Cognitive and Neurobiological Mechanisms of Perceptual Category Learning

Chair: Vincent Filoteo

V. FILOTEO. Neuropsychological Contributions to Understanding the Cognitive and Neurobiological Mechanisms of Perceptual Category Learning.

Symposium Description: The ability to categorize is a fundamental and important cognitive process that is required in nearly all aspects of our daily living. Fittingly, the study of category learning has maintained a prominent position in our attempts to understand human behavior. Given this important role, it is not surprising that category learning has been studied using several different approaches, including cognitive experimentation, mathematical modeling, and functional neuroimaging. In addition to these levels of inquiry, neuropsychological studies are critical for understanding the neurocognitive mechanisms involved in category learning, and the insights gained from this work have provided important constraints for theories of both the cognitive and neurobiological underpinnings of category learning. In keeping with the "transdisciplinary" theme of this conference, the symposium will present neuropsychological studies of category learning in various patient populations and will highlight how such studies have informed our understanding of the neuropsychology of category learning. Importantly, the studies presented all use a similar methodology, thus allowing for a more direct comparison across studies. In addition, each study applies well-established mathematical models to patients' performances to provide a better understanding of the nature of the observed deficits. Presentations will include studies in patients with focal frontal lesions, Parkinson's disease, pre-Huntington's disease, and focal basal ganglia lesions. The results indicate that a frontal-subcortical network is highly involved in the learning of various category structures, and provide strong evidence for a dissociation between category learning processes that rely on either a hypothesis testing system or a procedural-based system.

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G. ASHBY, S. QUELLER, S.A. JOHNSON, V.V. VALENTIN, J.C. STOUT, E. AYLWARD & J.S. PAULSEN. Category Learning in Prediagnosis Huntington's Disease.

Objective: Huntington's disease (HD) is associated with impairments in category learning, and research suggests that damage to the striatum may be a cause of these deficits (Filoteo, Maddox, & Davis, 2001; Knowlton, Squire, Paulsen, Swerdlow, Swenson, & Butters, 1996). Aylward et al. (1996) have shown a 50% reduction in the striatum's putamen volume already by the time of HD diagnosis, suggesting that category learning deficits may also be present prior to diagnosed HD. We investigated explicit and implicit category learning in people with the HD gene who were not yet diagnosed (preHD), and examined whether categorization performance was related to striatal volumes, motor symptoms, and estimated proximity to clinical diagnosis.

Participants and Methods: 307 preHD participants and 26 controls completed a rule-based task that required learning an explicit rule that was easy to verbalize; 286 preHD and 30 controls completed an information integration category learning task that required integrating information from separate perceptual dimensions in a way that was difficult to verbalize (implicit task).

Results: The preHD participants were impaired in both tasks, with poorer performance correlating with greater motor impairment. For the rule-based task, smaller striatal volumes were associated with slower learning. For the information-integration task, mathematical modeling showed that participants with more severe motor impairments failed to integrate perceptual information more often than participants with less motor impairment. In addition, smaller putamen volumes were associated with a decreased ability to integrate perceptual information.

Conclusions: These findings strongly implicate the striatum in both the rule-based and the information integration tasks.

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S.W. ELL, A. WEINSTEIN & R.B. IVRY. The Effect of Focal Basal Ganglia Lesions on Rule-Based and Information-Integration Category Learning.

Objective: We report the results of two experiments investigating the effect of focal basal ganglia pathology on category learning.

Participants and Methods: In the first experiment, seven patients with basal ganglia lesions (6 left side) were tested on rule-based and information-integration categorization tasks. In rule-based tasks, it is assumed that participants can learn the category structures through an explicit reasoning process. In information-integration tasks, optimal performance requires the integration of information from two or more stimulus dimensions, and participants are typically unaware of the categorization strategy. The second experiment compared two types of

rule-based categorization tasks that varied in terms of their demands on selective attention. In the unidimensional task, participants must attend to a relevant stimulus dimension while ignoring an irrelevant dimension; thus, the task requires learning to attend selectively to one dimension. In contrast, in the conjunction task, participants must attend to both dimensions.

Results: Consistent with previous studies involving patients with degenerative disorders of the basal ganglia, the patients were impaired on the rule-based task. In contrast, the patients were unimpaired on the information-integration task. Opposite the pattern observed in patients with degenerative disorders of the basal ganglia (i.e., Parkinson's disease), the focal lesion patients were impaired on the conjunction task, but not the unidimensional task.

Conclusions: These results provide evidence that further specifies the role of the basal ganglia in category learning and raise the intriguing possibility that focal basal ganglia lesions and disorders that alter dopamine systems might have opposite effects on rule-based category learning.

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D.M. SCHNYER, W.T. MADDOX, S.W. ELL, S. DAVIS & M. VERFAELLIE. Dissociable Executive Functions Predict Performance Separately for Rule-Based and Information Integration Category Learning: Evidence from Patients with Lesions to Frontal Cortex.

Objective: Previous research has revealed that the basal ganglia play a critical role in rule-based category learning (Ell et al., 2006; Maddox & Filoteo, 2006). While a direct role is probable, the BG also provide drive state input and reward feedback to the frontal cortex suggesting a frontal role in category learning (CL).

Participants and Methods: The current study examined category learning in 13 patients with damage to prefrontal regions.

Results: After 600 learning trials with feedback, these patients were found to be significantly less accurate than matched controls. This impairment was found both when category learning was rule-based (RB) and when it depended on information integration (II). The level of RB learning was correlated with performance on the Wisconsin Card Sorting Test, a test of abstract rule formation and the ability to shift and maintain rule implementation. In contrast, performance on II learning was marginally correlated with performance on the Stroop test, which taps the ability to inhibit inappropriate responses and resist interference. Consistent with the latter finding, the II learning impairment in the frontal patients reflected the use of a suboptimal RB approach.

Conclusions: These results demonstrate that in addition to the BG, the prefrontal cortex also plays a critical role in the acquisition and implementation of new category learning. Additionally, executive functions attributable to frontal cortex can play dissociable roles in different types of category learning and lesion analysis of the 13 patients may indicate specific regions associated with these dissociable functions.

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V. FILOTEO & W.T. MADDOX. Category Learning Deficits in Patients with Parkinson's Disease: Neuropsychological Underpinnings and Clinical Utility.

Objective: Patients with Parkinson's disease (PD) are impaired on a variety of category learning tasks, and until recently, such deficits were thought to be due to a common mechanism. In a series of recent studies, we demonstrated that PD patients can be impaired on both implicit (information-integration) and explicit (rule-based) category learning tasks. However, our work shows that the underlying cognitive deficits are distinct. This presentation provides an overview of these recent studies and demonstrates that the neurocognitive mechanisms underlying implicit and explicit category learning in PD are dissociable.

Participants and Methods: In our studies, PD patients were examined and compared to normal controls in various rule-based and information-integration category learning tasks. In each study, mathematical models were applied to participant's data so as to provide a more in-depth analysis of the nature of PD patient's deficits.

Results: Results indicate that the explicit category learning deficits observed in PD are due to impairments in selective attention and not working memory. In contrast, PD patients' implicit category learning deficits depend on the nature of the rule in that patients are primarily impaired when there is greater perceptual dissimilarity among the exemplars within the categories. Further, PD patients' deficits in implicit category learning predict future decline in global cognition above and beyond that predicted by more traditional neuropsychological measures.

Conclusions: Overall, this work indicates that PD can result in both implicit and explicit category learning deficits, but for very different reasons. Further, a detailed examination of such deficits can be helpful in predicting future changes in cognition in nondemented PD patients.

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Poster Session 10: Tramatic Brain Injury

9:00–10:30 a.m.

Other

G.L. IVERSON, M.W. COLLINS, M. ROBERGE & M.R. LOVELL. Preseason Neurocognitive Testing in Athletes with Academic Problems.

Objective: Baseline preseason neurocognitive testing is recommended for amateur and professional athletes. Then, if an athlete sustains a concussion, it can be determined more precisely when he or she returns to normal neurocognitive functioning. Baseline testing is particularly important if an athlete has a developmental condition, such as ADHD or a learning disability, because these conditions might have an adverse effect on cognitive functioning. However, the effect of learning problems and disabilities on test batteries used in athletics is unknown. The purpose of this study was to examine the effect of academic problems on preseason testing in amateur athletes.

Participants and Methods: Forty-one student athletes with academic problems (e.g., those who receive special education services or have repeated a grade) were compared to 41 randomly selected controls on ImPACT, a 20-minute computerized neurocognitive test battery. The two groups were compared on the five composite scores using MANOVA followed by univariate ANOVAs.

Results: There was a significant multivariate effect [Wilks' Lambda =.80; $F(6, 75)=3.1$, $p<.01$, eta squared=.20]. The ANOVA results revealed significantly worse test scores for students with academic problems on the Verbal Memory ($p<.014$, Cohen's d=.55) and Processing Speed ($p<.033$, d=.48) composites. The groups did not differ on the Visual Memory, Reaction Time, or Impulse Control composites. The students with academic problems also reported significantly more subjective symptoms on the Post-Concussion Scale ($p<.006$, Cohen's d=.70).